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A comparative analysis of smart city initiatives by China and India – Lessons for India

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ABSTRACT: *Seamless information access enabled by mobile technology combined with real-time sensing is beginning to change the way citizens inhabit their cities. Around the globe, there is increasing evidence of smart city experiments and implementation through leadership at a city level or at a national level. The analysis of the real-time functioning of the cities using sensing techniques and data analytics is seen by city administrators as an effective strategy to achieve seamless flow within a city. India's Smart Cities Mission is a step towards future-proofing its cities, an initiative that requires careful analysis of existing Smart City practices by other countries. India needs to adapt pertinent methodologies in terms of its governance of the mission, funding mechanism, business models for implementation, choosing the right smart city services and technology. One of India's frequent reference points is its neighbor China, which has consistently seen far higher levels of urbanization and initiated smart cities pilot projects far ahead of India. China's 'One city one policy' for all its 300 smart cities is a commendable approach. The National Smart City Joint Lab's continued work on Chinese smart cities standardization with a guidebook for city leaders and a people-centric urbanization approach are positive values for India to adapt. This paper compares the smart cities timelines of the two countries and analyses China's initiatives and responses to roadblocks to provide valuable insight to the local bodies, urban planners and designers in India.*

Keywords: Smart Cities, China, India, urbanisation

1.0 Introduction

The new age digital technology is creating several opportunities for cities to meet challenges in the 21st century. Real-time functioning of the cities could be better understood using sensing techniques, and data analytics to assist policy makers to devise long-term strategies. The increasing propagation of smartphones that enable access to information anywhere through the mobile network could alter the way citizens use the city. However, it is not an easy call for governments to analyse the challenges in terms of economic returns, value to citizens, implications on organisational structure, operational needs and how the investments fit within the realm of political and governmental strategies (Cosgrave & Doody, 2014). In pursuit of smart cities, city officials are moving away from the traditional top-down and closed approach

to planning, towards an open, transparent and inclusive governance system. The tools that are beginning to be employed in this process include – open and inclusive networks, open data infrastructure, visualisation, citizen engagement, simulation and gaming and integrated management structures (China Academy of Information and Communications Technology, 2015).

Historically, urbanisation in India has been largely unplanned and thus both spatial planning and maintenance of urban infrastructure has remained highly unsatisfactory (Ahluwalia et al., 2014). India, as a country still carries the tagline of a developing nation despite its growing economy and therefore it is necessary to take the right steps to realise its ambitions. The Indian government's initiative to implement 100 smart cities in India within the next two decades is an ambitious attempt considering the current standing of urban India (Anand, 2015). India launching its smart cities project is a step towards future-proofing its cities that require careful analysis and planning before implementation. One of India's frequent reference points is its neighbor China, which has consistently seen far higher levels of urbanisation and had initiated smart cities pilot projects several years before India. China, an emerging economy like India started expanding and constructing new cities almost a decade ahead of India, to meet the large-scale urban migration from rural China (Ren, 2012).

The study aims to critically analyse China's efforts to implement smart cities both in terms of successes and failures and based on the study, to draw suitable lessons for India. The key objectives are i) to retrace China's smart city journey and to understand the methodology it used, to juxtapose and compare with India's efforts and ii) to analyse the bottlenecks faced by China in implementing the smart city proposal, along with the trade-offs it had to make for the fast growth. Contextually, this is a significant comparison, as Dobbs & Sankhe (2010) note that never in history have two large countries (in terms of population) have urbanised at such a pace at the same time. The paper begins with an introduction on the smart city developments, then compares the timeline of China and India's smart city journey from available literature. It then considers China's methodology for its smart city mission and draw parallels with India's efforts by comparing policy documents. Finally some of the drawbacks of China's fast growth is discussed to gain insights .While the Indian approach is analysed using the Smart Cities Mission and Guidelines document (Ministry of Urban Development, 2015) , lack of policy documents in English is a major hurdle in researching on China's Smart Cities mission. Therefore, this study had to rely on reports commissioned by external agencies and academic works.

2.0 The Smart Cities Movement

City planning models conceived during the modern era – from the garden city movement to Le Corbusian factory boxes, to suburban models - were adapted, built, reproduced and finally rejected, leaving indelible and irreversible impressions on the urban landscape. Moving into the twenty-first century smart cities strategies are considered as long term visions by many cities around the globe like London, Helsinki, Melbourne, Brisbane, Vienna, Stockholm, and Paris. Smart cities seem to be the inevitable next step that has technology at the forefront of urban functioning (Yigitcanlar, 2016). However, there has been no accepted definition for smart cities to date, though there have been several competing ones from different sources. 'Smart city' is still regarded as a fuzzy concept and is often used interchangeably with other terms like wired, intelligent and digital cities. One highly cited definition declares cities to be "*smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable development and a high quality of life, with wise management of resources, through participatory governance*' (Giffinger & Gudrun, 2010). Hollands (2008) position on smart cities is that they should be based on human and social capital instead of focussing only on communication technology. It is a strong reference point in terms of achieving the balance between using advanced technology and still maintaining the humanness aspect.

Caragliu et al. (2011) identify six "axes" or dimensions of smart cities as *smart economy, smart mobility, smart environment, smart living, smart people and smart governance*. Hu (2015) states that the advancements in technology and knowledge have enabled new directions for policy-making to increase sustainability and urban competitiveness. Yigitcanlar & Lee (2014) concur that these advancements, especially in digital form have the potential to address some of the economic, environmental and social issues we are facing on a global scale. However, Bajracharya et al. (2014) argue that use of ICT alone cannot make a city smart unless it is complemented by other dimensions like cultural and natural amenities, knowledge and innovation precincts, people and skills and finally governance.

Yigitcanlar (2016) presents a detailed overview of the smart city practices of cities in various continents. Reviewing the available literature reveals that cities in different geographic locations around the world are experimenting with different aspects of technology. Sometimes, different cities within the same country are deploying different strategies to implement smart city technology, as a 'one size fits all' approach will not be appropriate. Therefore, the

challenge is identifying the possibilities and issues in positioning technology based urban planning and devising an appropriate guideline for India. The World Urbanisation Trends report (United Nations, 2014) highlights that China and India will account for more than one-third of the urban population increase expected between 2014 to 2050. This is in addition to 758 million already living in urban China and 410 million in urban India, accounting for half of the world urban population (Refer Fig.1). India and China present two unique cases in this scenario being the two most populous countries in the world, with China being a frontrunner in rapid urbanisation. Though each country and for that matter each city itself presents its own set of issues, India could learn more from China than any other country, when it comes to planning for urban development for the masses. The next section will aim to understand the smart city transformation in Chinese cities.

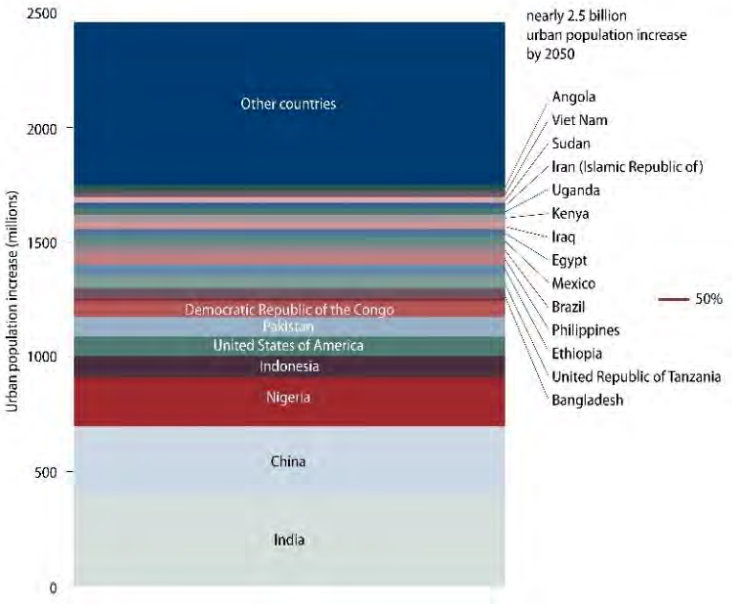

Fig 1: Contribution to increase in urban population by country

Source: (United Nations, 2014)

3.0 The Oriental Express

3.1 The Beginnings

Deren et al. (2015) identify three key events that have shaped and eventually culminated into the smart city transformation of Chinese cities. The “eight gold” project in 1995 initiated the era of urban informatization in China. The second event marked the development, by 1998 of digital urban infrastructure framework by 300 Chinese cities, facilitated by the national mapping geographic information bureau. The period 2006-2008 marked the third key event, with the development of internet of things and cloud computing technologies. This paved the way for the concept of smart cities that is based on intelligent infrastructure. Though smart cities are a consolidation of the early information infrastructure, they represent an advanced system that is based on integration and sharing of information resources of the underlying infrastructure and services.

Lu et al. (2015) share their view that the concept of the smart city in China has its roots in the 'digital city' fad amidst the main Chinese cities after the onset of the millennium. To complement this, the national administration of surveying, mapping, and geo-information developed the digital platform in 2006 for geo-information to serve as a planning platform for various cities. Likewise, since the beginning of the 1980s, intelligent concepts in buildings started taking shape in China. This initially was implemented primarily in public buildings and residential houses, slowly spreading to other typologies of buildings and finally expanded to the larger scale of the city. The Shanghai Expo in 2010 served as a transitional medium that resulted in many big Chinese cities setting their eyes on smart city developments (Zhou, 2014). This initiated the spurt in growth of technology centered cities that started developing at great pace, with the Shanghai Expo 2010 theme of 'Better City, Better Life' becoming the catalyst for China's initiation into creating smart cities. The Expo included high-level planning and included several information technology application systems to plan, construct and operate using GIS platforms, control passenger flow and security systems, manage energy and environmental parameters to name a few.

Though different authors share different perspectives, it is evident that China's National Smart City's mission (refer Fig:2) is a culmination of focussed urban transformation. Following these developments, the Ministry of Urban –Rural Development initiated the first smart cities pilot project for 90 cities which included prefecture-level cities, districts, and towns (refer Fig.2). The timeline depicts what followed next in China's journey. These pilot smart city projects had different levels of smart development planning identified individually for each city by their respective local governments. For instance, Beijing aimed to enable a 'smart life' for everyone while Ningbo city targeted 'smart logistics' for its international model port (Zhou, 2014). In short, China has had an explosive urban development that is centered on megaprojects in its major cities such as Beijing, Shanghai, Guangzhou, Shenzhen, Kunming and Chongqing (Smith, 2008).

The report by Central Policy Unit (GVT of Hong Kong), 2015 outlines the following five as the chief characteristics of China's smart city mission document proposal

- To promote green and low-carbon lifestyle and people-centric management of cities user-friendly systems

- To place high importance on development of strategic smart cities that are high on socio-economic index, with relevance given to a well-co-ordinated and top down design approach
- New cites planned should incorporate various smart city functions
- Inter-city collaboration to develop smart city clusters at the provincial level for a holistic approach
- To utilise Smart city as a tool to promote under developed regions in the country and to accelerate urbanisation in these areas

Figure 2: Timeline for China's Smart City Mission

Adapted from (Zhou, 2014), (D. Li, Cao, & Yao, 2015) & (Central Policy Unit (GVT of Hong Kong), 2015)

3.2 China's Methodology

China has one of the highest urbanisation rates among world countries with a rate of 52.6% reached in 2012. Various government departments along with city governments are promoting smart city developments in China. As of 2013, 311 Chinese cities had initiated smart city development including sub-provincial-level, prefectural level and country levels. In order to establish a scientific base and to act as a research think-tank, China Urban Science Research Council established the National Smart City Joint Laboratory. So far 19 joint laboratories have been set up with both domestic and foreign institutions for smart city science research (Chinese Society of Urban Studies, n.d.).

The European Commission and China report on smart cities partnership, comparing the smart city pilot projects of Europe and China (Kang et al., 2014), lists the following analysis of China's methodology along with the challenges faced on different fronts.

a. *Governance* – China follows the traditional 'top down' approach with each city having its own smart city leadership group with formal leadership structures. In addition, Key performance indicators (KPI) for each city, based on international benchmarks were established with open data system and portals were adopted as key priorities.
    - One of the main challenges faced is the difficulty in engaging with community stakeholders - comprising both small informal community groups and large-scale institutions - to align with different objectives. In addition, city governments need to overcome the risk of marginalising the services only to affluent sections of the community who owns smartphones. As a vast segment of the community will not have access to smartphones and other mobile technologies, provision should be made for a multi-channel strategy.
b. *Funding* – Chinese smart cities were funded through public funding mechanism at the local government level and in some cases from Provincial and National government. Additionally, m pilot smart cities set up established Local Government Financing Vehicles (LGFV) to enable cities to raise funds through a combination of bank loans, bonds, and equity market public offering. Cities like Tianjin, Chengdu and Qinghai were successful in getting foreign direct investment.
    - However, the funding challenges faced by China included – conveying the value in terms of cost-benefit to potential investors in private sector and increased government debts causing downgraded LGFV credit rankings of several Chinese cities. This leads to greater financial costs to fund smart cities project.
c. *Business Models* **–** Most pilot smart city projects are formed through public-private partnerships that work based on 'Build and Operate' or 'Build, Transfer, and Operate' or 'Build and Transfer' models. In most cases, the long-term risk falls on the private sector. -However, some Chinese cities have partnered with telecom companies to provide services to customers based on a profit/cost sharing basis.
    - The main challenge is that smart cities are a venture with no definitive completion stage. Therefore, it is essential to have a sustained model of operation even after the development goals are achieved.

d. *Smart city services* **–** Energy-based solutions and transport related applications are two of the most popular smart city services adopted by pilot cities around the world. However, several Chinese cities have also included public administration services as part of the smart services portfolio.

- The key challenges in smart city services include – multiple stakeholders as against a single customer requiring the advanced design of interfaces and managing the risk involving storing and controlling personal/confidential information due to open data access.

e. *Technology* **–**In terms of technology, the difficulties faced are

-*Broadband connectivity* **–**A high capacity connected network for both wireless and fixed operations is identified as a key element in Smart city infrastructure. This drives the requirement for a national and regional broadband infrastructure that could involve high implementation costs, especially in remote regions.

-*Internet of Everything* **–** A requirement for delivering technology-based services to everyone is to have an ICT network that would deliver the Internet of Everything (IoE) that connects all public assets information to the public. Up-grading of outdated IP networks coupled with a shortage in skilled technicians to implement could be a major hurdle for many city governments.

-*Smart personal devices* **–** Smartphones give considerable leverage in terms of accessible computing power that can generate big data. City governments could offer smartphone-based applications as smartphone numbers increase thereby helping to instantly connect with citizens. The drawback is the possible digital divide between citizens who possess a smartphone and ones who don't that needs to be considered while framing interfaces.

-*Cloud computing* **–** Cloud computing is another essential service that most Chinese cities are implementing. However, this is a challenging forum as it involves complex security issues, managing complex cloud components and interoperability, privacy issues and vendor lock-in danger.

-*Big data analytics* **–**Vast data from various applications and sources helps in gaining knowledge of city functioning and to improve productivity. However, processing huge amounts of data along with capturing and safely storing, sorting, sharing and analysing data are immense challenges to be considered.

4.0 India's Case – The Snail's pace

4.1 The Need

Several researchers have compared the distinct differences between the urbanisation paths chosen by India and China. Sankhe, Vittal, & Mohan (2011) highlight that India had a far greater level of urbanisation than China until 1950 but China marched ahead strongly, so that by 2005 41% of China's population lived in cities as against 29% in India for the same period. They also note that China had created a model for internal practices for this urban transformation that was consistent in terms of governance, urban planning, shape and pattern of urbanization policies across throughout the country and within the cities. On the contrary, India had underinvested on urban infrastructure spending with a relatively small amount of $17 per capita as against $ 116 by China (Dobbs & Sankhe, 2010). The other crucial observation is that the mayors of China's major cities were entrusted with more power and accountability than their Indian counterparts. The key difference in the urbanisation paths chosen by the two countries is that China has made a deliberate and systematic approach to managing its urban growth, while India barely noticed the inherent transformation that was occurring within. While China invested more on its cities than the demand, India underinvested. Therefore, it was the need of the hour for India to initiate drastic measures to cater to the growing demand for meeting infrastructure shortages.

4.2 Smart Cities Mission

One of the key visions highlighted by the new Indian Central government that came into power in 2014 was to build 100 smart cities as satellite towns of larger cities in India within the next 20 years, which was followed by allocating funds in the 2014-15 annual financial budgets (Bhattacharya et. al., 2015) . This triggered a huge interest not only within the country but also from various countries including Singapore, Germany, USA, Japan who are offering technological assistance (Sathiamoorthy, 2016). However, this initiative by the Indian Prime Minister Narendra Modi is considered by Poole (2014) as a response to China's inclusion of Smart cities doctrine in its grand urban plan. The Draft Concept Note on Smart Cities released by the Government of India identifies the growing pressure on urban areas of developing countries and the need for an organised growth to accommodate the future growth patterns (MoUD-GoI, 2014). Given a country of India's size in terms of population, though a delayed process, this is a crucial step leading to the future and that leads to India to look at best practices

by other countries. Bhan (2014) rings in a word of caution regarding this venture that these entrepreneurial new smart cities proposed do seem to be driven by corporate interests that could end up becoming oversized gated communities and exclusive zones that further deepen the social divide. The Smart cities mission is intended to be one of the key national priorities along with Swachh Bharat or Clean India Mission, Make in India and Digital India.

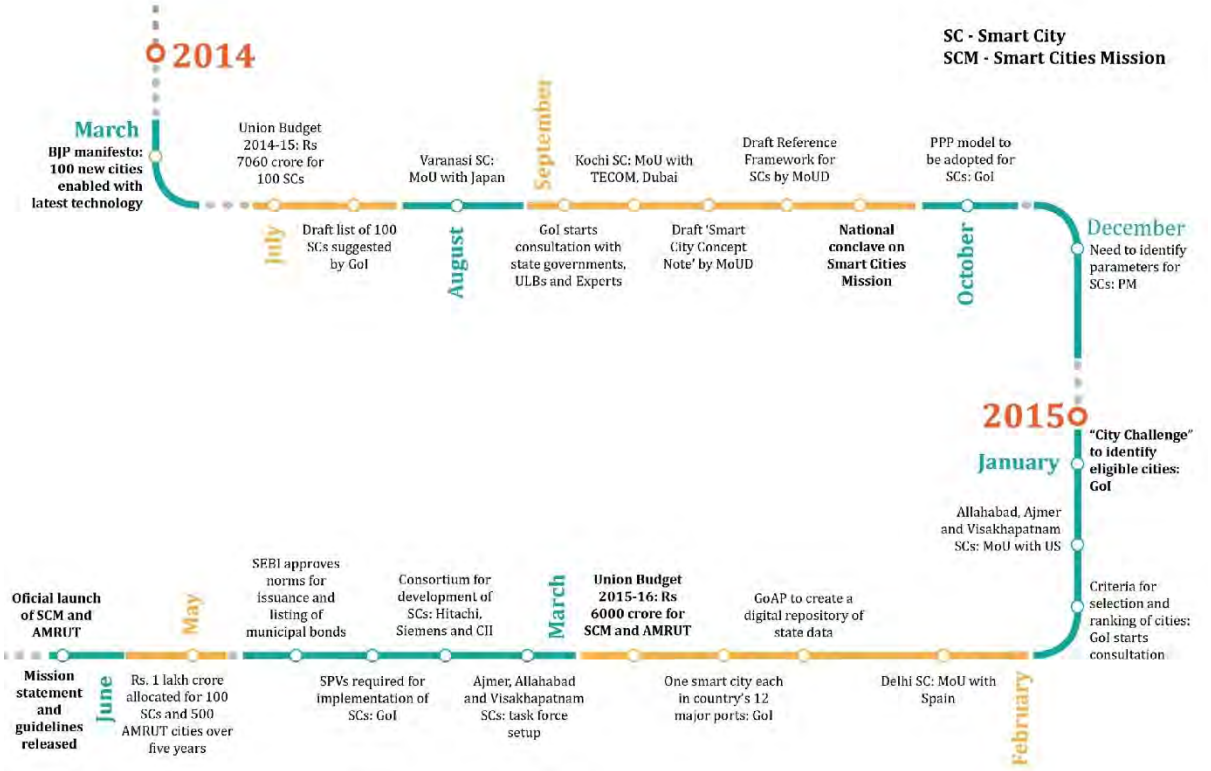

Figure 3: Timeline of India's Smart City Mission

Source: Bhattacharya et. al., (2015)

4.3 Comparison with China's Methodology

The smart cities mission document issued by Government of India (Ministry of Urban Development, 2015) enlists information on methods of implementing smart cities in India. While comparing this document to the China's methodologies, the following observations are made.

a. *Governance* – The Mission intends to devolve equal representation to all levels of government by incorporating Special Purpose Vehicle (SPV) for smart cities implementation, with governing members from Central, State and the Urban Local Body (ULB) or in other words the city government. The State Government and ULB will be 50:50 shareholders, with greater authority and flexibility given to the SPV for implementing the projects. This is a commendable action as one governing body could

deliver results faster and in an efficient manner than seeking approvals from multiple levels.

b. *Funding* **–** The Funding is announced as a centrally sponsored scheme (CSS) with approximately USD 15 million allocated by Central Government with an equal contribution to be made available by State and ULB. The funds by the local governments are expected to be generated from local user fees, land monetisation, debt collection, leverage borrowings from financial institutions, public-private partnerships (PPP) etc. However, there is far less clarity in terms of attracting investments from private sector and businesses (Ministry of Urban Development, 2015). Foreign investment and private investors will be motivated by profit margins and therefore cities with poor financial health could be considered unfavorably. Additionally, city based revenues are not viable for large infrastructure investments (Bhattacharya et al., 2015).Without substantial funding from government and viable financing mechanisms for securing investments, the inception of smart cities mission could be delayed

c. *Business Models* – There is no clear business model identified in the document as the proposal and implementation is a government driven initiative with certain projects to be implemented on PPP basis. Without following the profit/cost sharing basis adopted by Chinese cities, to generate private investments in projects may result in loss of funding/revenue creation opportunities for Indian cities. The fragmented nature of previous urban development implementation, such as Jawaharlal Nehru National Urban Renewal Mission (JNNURM), has resulted in non-achievement of key agendas (Kundu, 2014).

d. *Smart city services***-** The smart services envisaged in the encompasses - E-governance and citizen services, waste management, water management, energy management and urban mobility. The proposal looks at the strategy of retrofitting an identified area within a city, redevelopment of an existing built-up area with enhanced infrastructure and implementing at least one pan-city smart solution that involves technology usage. The focus is more on urban development for reducing the infrastructure lacunae in Indian cities.

e. *Technology*- Though the document frequently mentions Information Technology and Communication- enabled infrastructure developed, it does not indicate plans to improve nationwide broadband connectivity, establishing cloud computing for operations and big data analysis. The parallel mission of ‘Digital India’ launched in 2015 conceives broadband highways, e-governance at all levels, information for all and electronic

delivery of services as some of the central ideas of the mission.(Digital India, 2016). However, there is no cross-correlation between the 'Smart' and the 'Digital' India missions. Based on the literature, comparison of the ~~approaches~~ methodologies of both countries is tabulated below.

Table 1: Comparison of China and India's methodology

	CHINA	INDIA
Governance	Top down approach – with city level administrators given more powers to win funding from external agencies.	Special purpose vehicle (SPV) for devolution of administrative powers to all levels of government.
	One city one policy by National Smart City Joint Lab gives an overall framework, setting nationwide equal standards.	A broad guideline document outlining general features of the smart cities mission by the Ministry of Urban Development. Bureau of Indian standards (BIS) has independently issued the smart city indicators draft document.
	Key-performance indicators encourage individual cities to address city-centric issues.	Cities are advised to envisage their own developmental targets.
Funding	Combination of public funding from national government and establishment of city-level financing vehicles.	Funding on a 50-50 share basis between central and local governments. Source of funding at local government level not clearly specified.
Business models	Build and Operate/ Build, Transfer and Operate/ Build and Transfer models	Lacks clarity on specific revenue generation opportunities at the city level. Policy is too broad without identifiable methodologies.
Smart city services	Energy based solutions, transport related applications and e-governance platforms are widely adopted	Waste, energy & water management. E-governance and urban mobility are identified as primary smart city services

Technology	Plans in place for high capacity broadband connectivity, all public services in internet domain and cloud computing.	More detailed work is required on this front and planning required to correlate 'Smart Cities' and with 'Digital India' mission

The comparison draws significant lessons for India especially for funding, initiating clear business models and on the technology fronts. Lack of, or delayed funding have had a detrimental effect on India' previous urban regeneration measures (Kundu, 2014) and smart cities mission could follow suit if clear strategies are not put into place. Without determining the appropriate method of project implementation through partnerships, the mission's progress could be jeopardised. Likewise, clear targets and a common platform to monitor progress made by overlapping or complementary missions should be identified at all levels of the government. Though, China has made commendable progress by methodical planning and execution, there has been few compromises along the way, as seen in the next section.

5.0 Trade-offs in China's fast growth

5.1 Social inclusiveness

One of the key issues in China's fast growth is the 'hukuo' system of household registration that does not include close to 300 million rural to urban migrants. The conversion from rural to urban 'hukuo' is often impossible as it leaves these migrants with only limited access to government funding for education and healthcare. However, the 'urbanisation plan' released by China in 2014 recognises this issue and has set a conservative target of including at least 100 million into urban 'hukuo' by 2020 (The Economist, 2014). This case draws a parallel with India where the increased urbanisation is mainly due to rural-urban migration in cities like Mumbai that leads to informal settlements. The population in these new "census towns" are often not accounted for resulting in non-distribution of essential services (Biswas, 2011).

5.2 Environmental degradation

Woetzel et al. (2009) predicted that within the next decade, a number equivalent to the entire population of the United States would have made the journey from rural to urban China. Their findings are consistent with the World Bank's statistics in which the urban population in China grew from 48% in 2009 to 54% in 2014 (United Nations, 2014). However, this macro-migration has brought its own set of complications. China's one-fifth of cultivable land is

polluted and so is the case with drinking water in urban areas (Duggan, 2014). This has led to the increased outcry for a human-centric approach to development that puts social inclusiveness and environmental upgrade in the forefront. Ni and Zheng (2014) discuss the key role of urban competitiveness in increasing sustainability and innovation in cities. In their book, they explore how sprawling Chinese cities are defined by reduced economic efficiency and heightened environmental stress, which further leads to scarcity in resources, raw materials and greater demand for infrastructure and services. Therefore, they suggest that by promoting green growth and 'city branding', a singularly unique city image can be achieved. In short, striving to achieve a city that thrives on its human factor, natural surroundings, cultural attractions and efficient administrative services for its current residents and potential residents. Most Indian cities with million plus population, even without the same urbanisation pace as China, are already experiencing the flip side of development in terms of resource depletion and environmental pollution (Lakshmana, 2014)

5.3 Congestion concerns and Air pollution

Pucher et al. (2007) compare and contrast the urban transport policies and initiatives in India and China. They observed several key differences between the two and found that the land use and urban growth in Indian cities were more haphazard and unplanned leading to suburban sprawl in major Indian cities. Contrastingly they found that China had a more compact city planning despite similar population growth and rural to urban migration levels. Likewise, traditionally China had a heavy reliance on a non-motorised form of cycling and therefore had a good cycling infrastructure like bikeways, lanes, signals and parking in most of its cities. However, both cycling infrastructure and walking facilities are largely deficient in Indian cities. They also found that the quality of China's urban road network, public transport system and highway infrastructure to be far superior to its Indian counterpart. Though it has been almost a decade since this review was published, the current situation in India is little changed. Air pollution in Chinese cities due to traffic congestion often finds prominence in International media, however, Indian cities are far worse, being one among top ten worst countries in the world for air pollution exposure (Harris, 2014). The high urbanisation rate, population, and industrialisation are causes for continued high average PM2.5 levels in both China and India (Baklanov et al., 2016).

5.4 Energy demands

China's vast population demands high energy consumption and is currently the highest consumer in the world. A large percentage of its energy is from coal-based thermal power plants that are notorious for causing high levels of pollution. Compounding this situation, the expendable income of Chinese citizens has been growing exponentially which in turn increases the energy consumption. To address this China had initiated $4.3 billion on Smart grids since 2012 which is enabling optimisation of distribution networks and thereby addressing the surging demand sustainably (Downing, 2014). Likewise, China's efforts to install smart meters in all households by 2017 and then implement time-based electricity pricing, complements its smart cities mission (International Trade Administration, 2016). Integration of smart grid and smart metering to renewable energy sources is still in its infancy in India with pilot projects being experimented in some states (Thakur & Chakraborty, 2015)

5.5 Cleanliness – a positive trait

Not all development was negative and China had some relative advantages too, one such is overall cleanliness in its cities. China has a long history in public health drives in its cities that was perceived in the 1950s to avert the effects of chemical and biological effects because of the Korean War. The hygiene city campaigns (HCC) had instilled the sense of public hygiene and sanitation, city appearance, health education, in addition to the cleanliness of the water and food to control the spread of infectious diseases. The sustained drive that deployed a competition model for cities that had 60 indicative measures to rank performance (B. Li, 2011). Comparatively, India has only commenced a systematic approach to cleanliness through its 'Clean India' drive more than half a century later in 2014.

Conclusion

Transformation of existing urban areas to mitigate or heal their maladies is a universal challenge as each city comes with its own set of characteristics. In contrast to their Western counterparts China and India share several common characteristics, including being traditional societies, teeming with populous cities and being emerging economies. The above review indicates that there is a necessity for carrying out empirical research on the planning of smart city in India to understand the required policy frameworks and existing spatial dynamics. While India has seen a relatively slow paced development in the past two decades, India and China provide a very stark contrasting case studies in their journey to build smart cities. China gives

the impression of having made a planned transition in the last two decades to position itself for a smart transformation. While China – the oriental express, had embraced and shaped its cities with systematic development and long-term planning, India gives the appearance of just waking up to the urban realities and the inevitable transformation awaiting its cities. India's attempts to urbanisation have been at a snail's pace and the smart cities mission seem to be a knee-jerk reaction to the sudden realisation of not wanting to be left behind. It is evident that India is still in an exploratory phase and needs more work to move forward to the design and then the construction phase. Setting up a national laboratory to serve as a research forum and knowledge sharing platform will help India to move towards the next stage in its journey. Though China did have its own set of issues while implementing smart cities, it has valuable lessons to offer India.

References

Books/EBooks/Book Chapters

Ahluwalia, I. J., Kanbur, S. M. R., & Mohanty, P. K. (2014). *Urbanisation in India Challenges, Opportunities and the Way Forward*. New Delhi: SAGE Publications.

China Academy of Information and Communication Technologies (2015). *Comparative study of smart cities in Europe and China 2014*. Berlin, Heidelberg: Springer Berlin Heidelberg.

Ni, P., & Zheng, Q. (2014). *Urban competitiveness and innovation*. Cheltenham: Edward Elgar Publishing

Yigitcanlar, T. (2016). *Technology and the City : Systems, applications and implications*. Taylor and Francis.

Conference Proceedings

Bajracharya, B., Cattell, D., & Khanjanasthiti, I. (2014). Challenges and Opportunities to Develop a Smart City: A Case Study of Gold Coast, Australia. In *REAL CORP 2014* (Vol. 8, pp. 119–129). Vienna.

Li, B. (2011). Building healthy cities : the experience and challenges faced by China. *CITIES, HEALTH & WELL-BEING*.

Zhou, Y. (2014). The Path Towards Smart Cities in China: From the Case of Shanghai Expo 2010 Yanlin Zhou. In P. E. Manfred Schrenk, Vasily V. Popovich & Peter Zeile (Eds.), *REAL CORP 2014* (Vol. 8, pp. 1023–1027). Vienna.

Government/Other Publications

Bhattacharya, S., Rathi, S., Patro, S. A., & Tepa, N. (2015). *Reconceptualising Smart Cities: A Reference Framework for India*. Bangalore. Retrieved from http://niti.gov.in/writereaddata/files/document_publication/CSTEP Report Smart Cities Framework.pdf

Central Policy Unit (GVT of Hong Kong). (2015). Research Report on Smart City, (September), 98. Retrieved from http://www.cpu.gov.hk/doc/en/research_reports/CPU research report - Smart City(en).pdf

Cosgrave, E., & Doody, L. (2014). *Delivering the Smart City- Governing Cities in the Digital Age*. London. Retrieved from https://www.ucl.ac.uk/steapp/docs/delivering-the-smart-city

Dobbs, R., & Sankhe, S. (2010). Comparing urbanization in China and India, 1–3. Retrieved from http://www.mckinsey.com/insights/urbanization/comparing_urbanization_in_china_and_india

International Trade Administration. (2016). *2016 Top Markets Report Smart Grid*. Retrieved from http://trade.gov/topmarkets/pdf/Smart_Grid_Top_Markets_Report.pdf

Ministry of Urban Development. (2015). *Smart cities - Mission Statement & Guidelines*. http://doi.org/10.1016/S0264-2751(98)00050-X

Ministry of Urban Development -Government of India (MoUD-GoI). (2014). Draft Concept Note on Smart City Scheme. *Smart Cities*, *2014*, 1–46. http://doi.org/10.0

United Nations. (2014). *World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352)*. *New York, United*. http://doi.org/10.4054/DemRes.2005.12.9

Woetzel, J., Mendonca, L., Devan, J., Negri, S., Hu, Y., Jordan, L., … Yu, F. (2009). Preparing for China's urban billion. *Mc Kinsey Global Institute*, (March), 1–540. http://doi.org/www.mckinsey.com/mgi

Journal Articles

Baklanov, A., Molina, L. T., & Gauss, M. (2016). Megacities , air quality and climate. *Atmospheric Environment*, *126*, 235–249. http://doi.org/10.1016/j.atmosenv.2015.11.059

Bhan, G. (2014). The real lives of urban fantasies. *Environment & Urbanization*, *26*(1), 232–235. http://doi.org/10.1177/0956247813514305

Caragliu, A., del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, *18*(2), 65–82. http://doi.org/10.1080/10630732.2011.601117

Deren, L. I., Jianjun, C. A. O., & Yuan, Y. A. O. (2015). Big data in smart cities. *Science China Information Sciences*, *58*(October), 1–12. http://doi.org/10.1007/s11432-015-5396-5

Giffinger, R., & Gudrun, H. (2010). Smart cities ranking: an effective instrument for the positioning of the cities? *ACE: Architecture, City and Environment*, *4*(12), 7–26. Retrieved from http://upcommons.upc.edu/revistes/handle/2099/8550

Hollands, R. G. (2008). Will the real smart city please stand up? *City*, *12*(3), 303–320. http://doi.org/10.1080/13604810802479126

Hu, R. (2015). Sustainability and Competitiveness in Australian Cities. *Sustainability*, *7*(2), 1840–1860. http://doi.org/10.3390/su7021840

Kundu, D. (2014). Urban Development Programmes in India: A Critique of JnNURM. *Social Change*, *44*(4), 615–632. http://doi.org/10.1177/0049085714548546

Lakshmana, C. M. (2014). Dynamics of Urban Growth, Resource Degradation and Environmental Pollution in Million Plus Cities of India. *Environment and Urbanization Asia*, *5*(1), 49–61. http://doi.org/10.1177/0975425314521532

Li, D., Cao, J., & Yao, Y. (2015). Big data in smart cities. *Science China Information Sciences*, *58*(10), 1–12. JOUR. http://doi.org/10.1007/s11432-015-5396-5

Lu, D., Tian, Y., Liu, V., & Zhang, Y. (2015). The Performance of the Smart Cities in China—A Comparative Study by Means of Self-Organizing Maps and Social Networks Analysis. *Sustainability*, *7*(6), 7604–7621. http://doi.org/10.3390/su7067604

Pucher, J., Peng, Z., Mittal, N., Zhu, Y., & Korattyswaroopam, N. (2007). Urban Transport Trends and Policies in China and India: Impacts of Rapid Economic Growth. *Transport Reviews*, *27*(4), 379–410. http://doi.org/10.1080/01441640601089988

Ren, X. (2012). *Unlearning China's Lessons*. *The Wilson Quarterly* (Vol. 36). [Wilson Quarterly, Woodrow Wilson International Center for Scholars]. Retrieved from http://www.jstor.org/stable/wilsonq.

Sankhe, S., Vittal, I., & Mohan, a. (2011). Urban Giants: India and China, and their Urbanization Paths. *Environment and Urbanization Asia*, *2*(1), 1–12. http://doi.org/10.1177/097542531000200102

Smith, C. J. (2008). Monumentality in Urban Design: The Case of China. *Eurasian Geography & Economics*, *49*(3), 263–279. http://doi.org/10.2747/1539-7216.49.3.263

Thakur, J., & Chakraborty, B. (2015). A study of feasible smart tariff alternatives for smart grid integrated solar panels in India. *Energy*, *93*, 963–975. JOUR. http://doi.org/10.1016/j.energy.2015.09.100

Yigitcanlar, T., & Lee, S. H. (2014). Korean ubiquitous-eco-city: A smart-sustainable urban form or a branding hoax? *Technological Forecasting and Social Change*, *89*, 100–114. http://doi.org/10.1016/j.techfore.2013.08.034

Online Resources

Anand, S. (2015). Is India ready for Narendra Modi's "Smart Cities"? Retrieved from http://www.wsj.com/articles/BL-IRTB-28170

Biswas, S. (2011). Is India in the throes of "distress migration"? Retrieved from http://www.bbc.com/news/world-south-asia-15056418

Chinese Society of Urban Studies, C. (n.d.). Smart City Joint Laboratory. Retrieved October 23, 2016, from https://translate.googleusercontent.com/translate_c?depth=1&hl=en&prev=search&rurl=translate.google.com.au&sl=zh-CN&u=http://www.cityup.org/chinasus/intro/schema/center/Laboratory/index.shtml&usg=ALkJrhgv3yiU36E2Kpg1DCmXWDbD7jNa3g

Digital India. (2016). Programme Pillars. Retrieved October 24, 2016, from http://www.digitalindia.gov.in/content/programme-pillars

Downing, L. (2014). China Beats U.S. on Smart-Grid Spending for First Time. Retrieved from http://www.bloomberg.com/news/articles/2014-02-18/china-spends-more-on-energy-efficiency-than-u-s-for-first-time

Duggan, J. (2014). One fifth of China's farmland polluted. Retrieved from https://www.theguardian.com/environment/chinas-choice/2014/apr/18/china-one-fifth-farmland-soil-pollution

Harris, G. (2014). Beijing's Bad Air Would Be Step Up for Smoggy Delhi. Retrieved September 17, 2016, from http://www.nytimes.com/2014/01/26/world/asia/beijings-air-would-be-step-up-for-smoggy-delhi.html?_r=0

Poole, S. (2014). The truth about smart cities: "In the end, they will destroy democracy." Retrieved from http://www.theguardian.com/cities/2014/dec/17/truth-smart-city-destroy-democracy-urban-thinkers-buzzphrase

Sathiamoorthy, G. (2016). India's Smart Cities Need Smarter Utilities. Retrieved August 30, 2016, from http://www.huffingtonpost.in/g-sathiamoorthy-/indias-smart-cities-need-smarter-utilities/

The Economist. (2014). Moving on up: The government unveils a new "people-centred" plan for urbanisation. Retrieved from http://www.economist.com/news/china/21599397-government-unveils-new-people-centred-plan-urbanisation-moving-up